METHOD FOR ILLUMINATING DISPLAY ELEMENT, AND LIQUID CRYSTAL DISPLAY DEVICE

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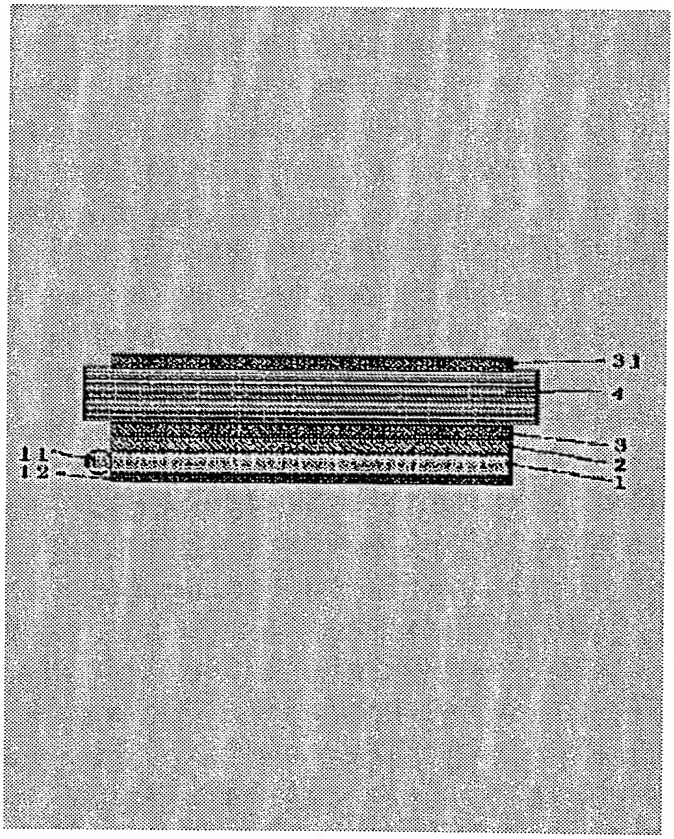
Abstract of **JP11003608**

PROBLEM TO BE SOLVED: To eliminate the necessity of improving luminance of a light source accompanied by power consumption increase and achieve a bright display by improving light use efficiency. SOLUTION: In this method, a polarized light controlling layer 2 which varies a vibrating plane of linearly polarized light is installed on a light emitting side of a light guiding plate 1 which emits the incident light, which is entered from the side thereof, from either upper surface or lower surface, and the parallel degree of the vibrating plane of the linearly polarized light, which is emitted from light guiding plate 1, to a transmission axis of the polarizing plate 3 which is installed on the light guiding plate 1 side of a transmission display element 4 is improved through the polarized light controlling layer 2 and the linearly polarized light enters the polarizing plate 3. Thereby, the absorption loss due to the polarizing plate 3 can be suppressed so that the transmittance of the polarizing plate 3 can be increased to improve the display brightness of the display element. Comparing with the conventional method, if the display brightness is same, the luminance of the light source can be decreased to reduce the power consumption and enhance the life of the battery in the display element of the battery power supply type such as portable personal computers.



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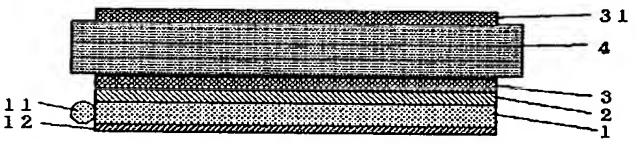
(54)【発明の名称】　表示素子の照明方法及び液晶表示装置

(57)【要約】

【課題】　光利用効率の向上を図ることにより、消費電力の向上を伴う光源輝度の向上化の必要なく明るい表示を達成できる表示素子の照明方法、及び表示の明るさに優れる透過型液晶表示装置の開発。

【解決手段】　側面からの入射光を上下面の一方より出射する導光板（１）の光出射側に、直線偏光の振動面を変化させる偏光制御層（２）を設けてその偏光制御層を介し、透過型表示素子（４）に設けた導光板側の偏光板（３）の透過軸に対する、導光板より出射した直線偏光の振動面の平行度を高めてその直線偏光を前記偏光板に入射させる表示素子の照明方法、及びその方法を用いた液晶表示装置。

【効果】　偏光板による吸収ロスを抑制でき、偏光板透過率の増大で表示素子における表示の明るさを向上でき、従来と同じ明るさとするときには、光源の輝度を低下できて消費電力を低減でき、携帯用パソナルコンピュータ等の電池電源式の表示素子における電池寿命を向上できる。



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【特許請求の範囲】

【請求項１】　側面からの入射光を上下面の一方より出射する導光板の光出射側に、直線偏光の振動面を変化させる偏光制御層を設けてその偏光制御層を介し、透過型表示素子に設けた導光板側の偏光板の透過軸に対する、導光板より出射した直線偏光の振動面の平行度を高めてその直線偏光を前記偏光板に入射させることを特徴とする表示素子の照明方法。

【請求項２】　側面からの入射光を上下面の一方より出射する導光板、その光出射側に配置された位相差板、その位相差板の上側に偏光板を介して配置された透過型液晶セルを少なくとも有してなり、前記の位相差板が導光板の入射側面に対する面内法線と、導光板側の偏光板の透過軸とがなす角の中間に光学軸が位置するように配置されていることを特徴とする液晶表示装置。

【請求項３】　側面からの入射光を上下面の一方より出射し、その光出射側にプリズムアレイ層を有する導光板、そのプリズムアレイ層の上側に配置された位相差板、その位相差板の上側に偏光板を介して配置された透過型液晶セルを少なくとも有してなり、前記の位相差板がプリズムアレイ層におけるプリズム頂点の稜線に対する平面方向の垂直線と、導光板側の偏光板の透過軸とがなす角の中間に光学軸が位置するように配置されていることを特徴とする液晶表示装置。

【請求項４】　請求項２又は３において、位相差板の光学軸の角度をθ_R、導光板の入射側面に対する面内法線の角度をθ_L、プリズムアレイ層のプリズム頂点の稜線方向の角度をθ_T、導光板側の偏光板の透過軸の角度をθ_Pとしたとき、式：$\theta=(\theta_L+\theta_P)/2$又は$(\theta_T+\theta_P)/2$で定義される$\theta$に対して$\theta_R$が±５度の範囲にある液晶表示装置。

【請求項５】　請求項２～４において、位相差板の位相差が波長５５０nmの光に基づき２００～３００nmである液晶表示装置。

【請求項６】　請求項２～５において、位相差板の配置角度を決定する光学軸が進相軸である液晶表示装置。

【請求項７】　請求項２～６において、位相差板がその面内屈折率をn_x、n_y（ただし$n_x \geqq n_y$）、厚さ方向の屈折率をn_zとしたとき、式：$N_z=(n_x-n_z)/(n_x-n_y)$で定義されるN_zに基づき、$0 \leqq N_z \leqq 3$を満足するものである液晶表示装置。

【請求項８】　側面からの入射光を上下面の一方より出射する導光板、その光出射側に配置された旋光子、その旋光子の上側に偏光板を介して配置された透過型液晶セルを少なくとも有してなり、前記の旋光子が導光板の入射側面に対する面内法線と、導光板側の偏光板の透過軸がなす角度に対して、波長５５０nmの光に基づき±１０度の範囲の旋光角を示すものであることを特徴とする液晶表示装置。

【請求項９】　側面からの入射光を上下面の一方より出射し、その光出射側にプリズムアレイ層を有する導光板、そのプリズムアレイ層の上側に配置された旋光子、その旋光子の上側に偏光板を介して配置された透過型液晶セルを少なくとも有してなり、前記の旋光子がプリズムアレイ層におけるプリズム頂点の稜線に対する平面方向の垂直線と、導光板側の偏光板の透過軸がなす角度に対して、波長５５０nmの光に基づき±１０度の範囲の旋光角を示すものであることを特徴とする液晶表示装置。

【請求項１０】　請求項２～９において、位相差板又は旋光子が導光板側の偏光板と接着一体化されてなる液晶表示装置。

【発明の詳細な説明】

【０００１】

【発明の技術分野】本発明は、光の利用効率に優れて明るい表示を達成できる表示素子の照明方法、及びその方法による透過型の液晶表示装置に関する。

【０００２】

【発明の背景】従来、側面からの入射光を上下面の一方より出射するようにした導光板からなる導光板型光源の上に、両側に偏光板を有する液晶セルを配置してなり、必要に応じ偏光板と液晶セルとの間に、液晶セルの複屈折による光学特性を補償するための補償位相差板を配置してなる透過型の液晶表示装置が知られていた。導光板側の偏光板の透過軸等に基づく配置角度は、液晶の配向方向に基づいて決定され、例えばＴＮ型液晶では通例４５度又は－４５度である。

【０００３】しかしながら、導光板型光源より導光板側の偏光板に入射した光の通例５０％以上が偏光板に吸収され、その吸収ロスが大きくて光の利用効率に劣り、液晶表示装置の表示の明るさの向上を阻む問題点があった。光源の輝度を向上させて明るさの向上を図ることは可能であるが、その場合には消費電力の向上を伴うこともさりながら、光源温度も上昇して偏光板等に光学歪が発生しやすくなり、表示品位が低下しやすくなる。

【０００４】

【発明の技術的課題】本発明は、光利用効率の向上を図ることにより、消費電力の向上を伴う光源輝度の向上化の必要なく明るい表示を達成できる表示素子の照明方法、及び表示の明るさに優れる透過型液晶表示装置の開発を課題とする。

【０００５】

【課題を解決するための手段】本発明は、側面からの入射光を上下面の一方より出射する導光板の光出射側に、直線偏光の振動面を変化させる偏光制御層を設けてその偏光制御層を介し、透過型表示素子に設けた導光板側の偏光板の透過軸に対する、導光板より出射した直線偏光の振動面の平行度を高めてその直線偏光を前記偏光板に入射させることを特徴とする表示素子の照明方法、及びその方法を用いた液晶表示装置を提供するものである。

【０００６】

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【発明の効果】本発明によれば、偏光板にその透過軸との平行度が高い直線偏光を入射させることができて、偏光板による吸収ロスを抑制でき、偏光板透過率の増大で従来と同じ光源を用いても液晶表示装置等の表示素子における表示の明るさを向上させることができる。また従来と同じ明るさとするときには、光源の輝度を低下できて消費電力を低減でき、携帯用パソナルコンピュータ等の電池電源式の表示素子における電池寿命を向上させることができる。

【０００７】前記の効果は、導光板よりの出射光を部分偏光としたとき、その直線偏光には屈折率の異なる媒体の界面に斜め入射した光のブルースター角等の入射角度と反射条件の関係よりＳ偏光よりもＰ偏光を多く含み、従ってそのＰ偏光の振動面を制御して偏光板を透過しやすくすることにより光の利用効率を向上させうる如く、導光板より出射した楕円偏光等も含む偏光の振動面や楕円率等の偏光特性が偏光制御層を介し変換されて導光板側の偏光板を透過しやすくなり、吸収ロスが抑制されて透過率が向上することによるものと考えられる。

【０００８】

【発明の実施形態】本発明の照明方法は、側面からの入射光を上下面の一方より出射する導光板の光出射側に、直線偏光の振動面を変化させる偏光制御層を設けてその偏光制御層を介し、透過型表示素子に設けた導光板側の偏光板の透過軸に対する、導光板より出射した直線偏光の振動面の平行度を高めてその直線偏光を前記偏光板に入射させるものである。

【０００９】前記した表示素子の照明方法の実施は、例えば側面からの入射光を上下面の一方より出射する導光板の光出射側に位相差板を配置し、その位相差板の上側に偏光板を介して透過型表示素子を配置すると共に、前記位相差板の配置に際してその光学軸を導光板の入射側面に対する面内法線と、導光板側の偏光板の透過軸とがなす角の中間に位置させることにより行うことができる。

【００１０】図１に前記照明方法を実施した液晶表示装置を例示した。１が導光板、２が位相差板、３が導光板側の偏光板、４が透過型の液晶セルであり、位相差板２は、その光学軸が導光板１の入射側面に対する面内法線と、導光板側の偏光板３の透過軸とがなす角の中間に位置するように配置されている。なお図中の１１は光源、１２は反射層、３１は視認側の偏光板である。

【００１１】また図２に前記の照明方法を実施した他の液晶表示装置を例示した。これは、光出射側にプリズムアレイ層５を有する導光板１を用いたものである。この場合には位相差板２はプリズムアレイ層５の上側に、その光学軸がプリズムアレイ層５のプリズム頂点の稜線に対する平面方向の垂直線と、導光板側の偏光板３の透過軸とがなす角の中間に位置する状態に配置されている。

【００１２】前記に例示の液晶表示装置では、導光板１

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がその側面に配置した光源１１からの入射光を底面等を介し上面より出射し、その出射光がプリズムアレイ層５がある場合にはそれを透過して位相差板２に入射した後、偏光板３、液晶セル４、視認側偏光板３１に順次入射して、その偏光板３１より表示光が出射される。

【００１３】従って上記した図１、図２の実施例は、直線偏光の振動面を変化させる偏光制御層として位相差板２を用いたものである。これによれば、導光板１又はプリズムアレイ層５より出射した光の内の直線偏光の振動面が、偏光制御層としての位相差板２を透過する際に変換され、その位相差板の光学軸の配置角度を前記中間としたので位相差板より出射する際には、導光板側の偏光板３の透過軸と平行度の高い振動面を有する直線偏光となり、それにより導光板側の偏光板３による吸収ロスが抑制されて透過率が増大し、透過型液晶表示装置の輝度が向上する。

【００１４】前記の如く、本発明における直線偏光の振動面を変化させる偏光制御層は、導光板又はプリズムアレイ層より出射した光の偏光状態を制御して、導光板側の偏光板を吸収ロスなく透過しやすい光に変換することを目的とする。従って偏光制御層としては、例えば位相差板や旋光子の如く直線偏光の振動面を変化させうる適宜な光学素子を用いうる。

【００１５】ちなみに図３、図４に、旋光子７を用いて本発明の照明方法を実施した液晶表示装置を例示した。図３に例示の液晶表示装置では、上記の位相差板２に代わる旋光子７が導光板６の上側に配置されており、その旋光子として、導光板６の入射側面に対する面内法線と、導光板側の偏光板３の透過軸がなす角度に対し、波長５５０nmの光に基づき±１０度の範囲の旋光角を示すものが用いられている。

【００１６】一方、図４に例示の液晶表示装置では、光出射側にプリズムアレイ層５を有する導光板６を用いており、この場合にはその旋光子７として、プリズムアレイ層におけるプリズム頂点の稜線に対する平面方向の垂直線と、導光板側の偏光板の透過軸がなす角度に対して、波長５５０nmの光に基づき±１０度の範囲の旋光角を示すものが用いられている。

【００１７】前記図３、図４に例示の液晶表示装置では、導光板６がその側面に配置した光源１１からの入射光を底面等を介し上面より出射し、その出射光がプリズムアレイ層５がある場合にはそれを透過して旋光子７に入射した後、偏光板３、液晶セル４、視認側偏光板３１に順次入射して、その偏光板３１より表示光が出射される。

【００１８】前記においては、導光板６又はプリズムアレイ層５より出射した光の内の直線偏光の振動面が、偏光制御層としての旋光子７を透過する際に変換され、その旋光子として所定の旋光角を示すものを用いたことより旋光子より出射する際には、導光板側の偏光板３の透

過軸と平行度の高い振動面を有する直線偏光となり、それにより導光板側の偏光板３による吸収ロスが抑制されて透過率が増大し、透過型液晶表示装置の輝度が向上する。

【００１９】なお上記では、直線偏光に基づく輝度の向上作用を説明したが、偏光制御層による位相差等の光学特性の変化は、直線偏光以外の光にも及ぶことより、本発明による液晶表示装置の輝度向上作用には、直線偏光以外の光も偏光制御層を介して偏光板を透過しやすい光に変換されて輝度向上に寄与していると考えられる。

【００２０】本発明の照明方法は、透過型液晶セルの如く偏光板を介し直線偏光を入射させて表示目的を達成する適宜な表示素子に適用でき、就中、透過型液晶表示装置に好ましく適用することができる。透過型の液晶表示装置は一般に、偏光板と透過型液晶セルとバックライト、及び必要に応じてのプリズムシート等からなるプリズムアレイ層や拡散板、補償用位相差板等の構成部品を適宜に組立てて駆動回路を組込むことなどにより形成される。本発明においては、バックライトとして側面からの入射光を上下面の一方より出射する導光板を用い、その導光板又は導光板上のプリズムアレイ層と導光板側の偏光板との間に所定の偏光制御層を設ける点を除いて特に限定はなく、従来に準じて液晶表示装置を形成しうる。

【００２１】導光板としては、図例の如く底面に必要に応じ反射層１２，６１を有して、側面からの入射光を上下面の一方より出射するようにした適宜なものを用いることができ、光を吸収なく効率的に出射するものが好ましく用いられる。（冷，熱）陰極管等の線状光源や発光ダイオード等の光源を導光板の側面に配置し、その導光板に導光板内を伝送される光を拡散や反射、回折や干渉等により板の片面側に出射するようにした、従来の透過型液晶表示装置で公知の導光板などはその例である。

【００２２】ちなみに内部の伝送光を片面側に出射するようにした一般的な導光板としては、透明又は半透明の樹脂板の光出射面又はその底面にドット状やストライプ状等の拡散体を設けたものや、樹脂板の底面に凹凸構造、特に微細プリズムの配列構造を設けたものなどがあげられる。本発明にては、偏りの大きい光を出射する導光板が有利に用いうる。

【００２３】なお導光板の底面に必要に応じて設けられる反射層は、伝送光の反射や漏光防止などを目的とし、凹凸面等で代表される拡散反射層、アルミニウムや銀等の蒸着層、それを設けた樹脂板や金属箔等からなる金属面で代表される鏡面反射層などの適宜な反射層として形成してよい。反射層は、導光板底面への塗布層や塗工層、あるいは反射板などの適宜な形態で設けてよい。

【００２４】導光板の上に必要に応じて配置するプリズムアレイ層は、導光板より出射した光の進路方向を制御して、液晶表示装置の視認に有利な導光板に垂直ないし

垂直に近い状態で出射する光の増量を目的とする。プリズムアレイ層は、導光板の光出射面を微細プリズムの配列構造に成形する方式等により導光板の形態として付与することもできるし、プリズムシート等の付設方式により導光板とは別体のものとして付与することもできる。

【００２５】導光板上に配置するプリズムアレイ層のアレイ配列方向は、任意であり通例、導光板の入射側面に平行か垂直な方向とされる。本発明において導光板上にプリズムアレイ層がある場合、偏光制御層の配置角度や旋光角は、上記したように導光板ではなく、プリズムアレイ層におけるプリズム頂点の稜線方向に基づいて決定される。

【００２６】導光板の形成に際しては、発光を均一化するための拡散板や光源からの出射光を導光板の側面に導くための光源ホルダなどの適宜な補助手段を必要に応じ所定位置に１層又は２層以上配置して適宜な組合せ体とすることができる。なお、拡散板の配置位置は、導光板と偏光制御層の間、導光板上にプリズムアレイ層がある場合には導光板とプリズムアレイ層の間が一般的であるが、これに限定されない。

【００２７】偏光制御層としての位相差板は、入射した偏光の楕円率や方位角等の偏光特性を変換するためのものである。方位角の変換は、入射偏光の偏光軸と位相差板の光学軸がなす角をξとしたとき、位相差板による位相差に応じて２ξの範囲で行うことができる。ちなみに直線偏光では、１／２波長の位相差を与えたとき偏光軸の角度変化が最大となり、出射光の楕円率等の偏光状態の変化もなしに振動面の方位角のみを変化させることができる。

【００２８】従って光伝送の主流方向、すなわち導光板では入射側面に対する面内法線方向、プリズムアレイ層ではプリズム頂点の稜線に対するプリズムアレイ層平面に平行な垂直方向と、導光板側の偏光板の透過軸とがなす角の中間、就中、中央部に光学軸が位置するように位相差板を配置し、その位相差板を介して偏光の方位角を導光板側の偏光板の透過軸と可及的に平行となるように変換することにより、偏光板による吸収ロスを低減できて透過率を高めることができる。ちなみに直線偏光の振動面と偏光板の透過軸がなす角をϕ、入射光の強度をI_0、平行位透過率をH_0としたとき出射光の強度（Ｉ）は$I = I_0 H_0 \cos^2 \phi$で求めることができる。

【００２９】偏光制御層を形成する位相差板には、適宜な位相差を付与するものを用いることができ、特に限定はない。導光板又はプリズムアレイ層より出射した光は、自然光に直線偏光が混合した部分偏光としての特性を示すことからその偏光特性の解消を防止する点より、すなわちかかる偏光特性を有効利用する点より、$m\lambda + \lambda/2$（ただしmは任意な整数、λは波長）の位相差を与える位相差板が好ましい。

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【００３０】また前記のmが増えると波長分散により前記の式に適合しない波長範囲が増大して前記の偏光特性を解消する波長光が増えることより、mは０であることが好ましい。従って広い波長域でλ／２ないしその近傍の位相差を示す位相差板が好ましく、液晶表示装置の視認光が可視光である点より、４００～７００nm、就中５００～５８０nmの波長域でλ／２ないしその近傍の位相差を示す位相差板、特に波長５５０nmの光に基づき２００～３００nmの位相差を示す位相差板が好ましい。

【００３１】位相差板の光学軸に基づく配置角度は、その位相差等に応じて適宜に決定しうる。輝度向上等の点よりは、位相差板の光学軸の角度をθ_R、導光板の入射側面に対する面内法線の角度をθ_L、プリズムアレイ層のプリズム頂点の稜線方向の角度をθ_T、導光板側の偏光板の透過軸の角度をθ_Pとしたとき、式：$\theta=(\theta_L+\theta_P)/2$又は$(\theta_T+\theta_P)/2$で定義される$\theta$に対して、$\theta_R$が±５度の範囲にあることが好ましい。

【００３２】特に位相差板がλ／２の位相差を与える場合には、上記したように導光板の入射側面に対する面内法線方向、プリズムアレイ層を設けた導光板ではそのプリズム頂点の稜線に対する平面方向の垂直方向と、導光板側の偏光板の透過軸とがなす角の中央部（真中）に光学軸を位置させた配置が輝度の向上等の点より好ましい。

【００３３】また前記において、位相差板の配置角度を決定する光学軸は、斜め透過光の有効利用などの点より進相軸とすることが好ましい。遅相軸では、斜め透過光に対する位相差板の光学軸変化と偏光板の偏光軸変化の方向が逆転して斜め透過光、従って液晶表示装置を斜めから視認する場合の視認光の偏光板透過率が低下する場合がある。

【００３４】位相差板の光学軸変化量と偏光板の偏光軸変化量の均等化をはかって透過率を増大させる点、特に前記した斜め透過光の透過率も増大させる点よりは式：$N_z=(n_x-n_z)/(n_x-n_y)$で定義されるN_zに基づき、$0\leqq N_z\leqq 3$を満足する位相差板が好ましい。なおn_x、n_yは、位相差板の面内屈折率（ただし$n_x\geqq n_y$）、n_zは厚さ方向の屈折率である。N_zが前記範囲外では、斜め透過光の透過率増大効果に乏しい。

【００３５】偏光制御層を形成する位相差板は、位相差の制御などを目的に１層又は２層以上の位相差層からなっていてよい。位相差が相違する２層以上の位相差層の重畳、あるいは位相差が同じの又は相違する位相差層の光学軸を交差させた重畳は、目的の偏光特性に変換する波長域の拡大に有効である。

【００３６】位相差板、ないしそれを形成する位相差層には、複屈折性を示す適宜なものを用いうる。ちなみにその例としては、高分子フィルムを一軸や二軸等で適宜に延伸処理してなるフィルムや、液晶ポリマーフィルム等からなる位相差フィルムなどがあげられる。前記高分

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子フィルムの例としては、ポリカーボネート、ポリエステル、ポリスルホン、ポリエーテルスルホン、ポリビニルアルコール、ポリスチレン、ポリメチルメタクリレート、ポリプロピレンやその他のポリオレフィン、酢酸セルロース系ポリマー、ポリ塩化ビニル、ポリアリレート、ポリアミドの如き適宜な透明プラスチックからなるフィルムなどがあげられる。

【００３７】位相差板は、一般にその材質に特有の波長分散を示し、通例、短波長側の光ほど大きい位相差となるが、本発明にては波長分散の低い位相差板、就中、逆分散を示す位相差板が好ましい。

【００３８】偏光制御層としての旋光子は、その旋光性を利用して入射した偏光の方位角等の偏光特性を変換するためのものであり、位相差の影響が発生しないピッチとした場合には、偏光の状態変化なしに方位角のみを回転させて変換することができる。旋光子による方位角の変換は、旋光角θとして表すことができ、その偏光軸の回転方向を正方向として入射偏光の偏光軸と導光板側偏光板の透過軸がなす角をηとしたとき、ｎ・１８０度$<\theta<$ｎ・１８０度＋２η（ただしｎは任意な整数）を満足する旋光角を示す旋光子が用いうる。輝度の向上等の点よりは、$\theta=$ｎ・１８０度＋ηの旋光角を示す旋光子が好ましい。また波長分散の抑制の点よりは、ｎの小さいもの、就中０のものが好ましい。

【００３９】液晶表示装置の形成には、輝度向上の点などより、導光板の入射側面に対する面内法線、又はプリズムアレイ層を配置した導光板ではそのプリズムアレイ層におけるプリズム頂点の稜線に対する平面方向の垂直線と、導光板側の偏光板の透過軸がなす角度に対して、波長５５０nmの光に基づき±１０度の範囲の旋光角を示す旋光子が好ましく用いられる。

【００４０】旋光子は、旋光性を示す適宜な材質からなるものであってよい。その例としては、低分子量液晶や高分子量液晶、あるいはそれらを組合せたものなどがあげられる。旋光性等の点より好ましい液晶は、ツイストネマック構造を示すものである。

【００４１】液晶からなる旋光子は、例えば低分子液晶層をフィルム等の透明基材で挟持したセル形態、高分子量液晶ないし液晶ポリマーからなる層を透明基材で支持した形態、液晶ポリマーのフィルムからなる形態、それらの形態物を適宜な組合せで重畳した形態などの適宜な形態で得ることができる。液晶ポリマーフイルムは、例えば剥離コートを設けた基材上に液晶ポリマー層を形成してそれを基材より剥離する方式などにより得ることができる。

【００４２】前記の透明基材としては、例えばトリアセチルセルロースやポリビニルアルコール、ポリイミドやポリアリレート、ポリエステルやポリカーボネート、ポリスルホンやポリエーテルスルホン、エポキシ系樹脂の如きプラスチックからなるフイルム、あるいはガラス板

などの適宜なものを用いうる。

【００４３】液晶層の形成は、従来の配向処理に準じた方法で行いうる。ちなみにその例としては、基材上にポリイミドやポリビニルアルコール等の膜を形成してレーヨン布等でラビング処理したものや、SiO_2の斜方蒸着層等からなる適宜な配向膜の上に液晶を展開する方式などがあげられる。展開は、バーコーターやスピナー、ロールコーター、グラビア印刷方式などの適宜な塗工機にて行うことができる。

【００４４】なお高分子液晶ないし液晶ポリマーの場合には、配向膜上に液晶を展開したのちガラス転移温度以上、等方相転移温度未満に加熱して液晶を配向させ、それをガラス転移温度未満に冷却してガラス状態とし、当該配向が固定化された固化層を形成する方式などがあげられる。

【００４５】高分子液晶ないし液晶ポリマーの展開は、加熱溶融方式や溶剤による溶液として行うことができる。その溶剤としては、例えば塩化メチレンやシクロヘキサノン、トリクロロエチレンやテトラクロロエタン、Ｎ－メチルピロリドンやテトラヒドロフランなどの適宜なものを用いうる。展開に際しては、必要に応じ配向膜を介した液晶層の重畳方式なども採ることができる。

【００４６】透過型液晶セル等の表示素子の導光板側、及び必要に応じて視認側に配置される偏光板としては、適宜なものを用いてよく特に限定はない。一般には、偏光フィルムからなるものが用いられる。その例としては、ポリビニルアルコール系や部分ホルマール化ポリビニルアルコール系、エチレン・酢酸ビニル共重合体系部分ケン化物の如き親水性高分子のフィルムにヨウ素及び／又は二色性染料を吸着させて延伸したもの、ポリビニルアルコールの脱水処理物やポリ塩化ビニルの脱塩酸処理物の如きポリエン配向フィルムなどがあげられる。

【００４７】就中、偏光度等の点より親水性高分子フィルムにヨウ素及び／又は二色性染料を吸着させたものが好ましく用いうる。偏光フィルムの厚さは通例５～８０μmであるが、これに限定されない。用いる偏光板は、偏光フィルムの片面又は両面を透明保護層等で被覆したものなどであってもよい。またその透明保護層は、微粒子の付着や含有で表面に微細凹凸構造を有するものであってもよい。

【００４８】前記の微粒子には、例えば平均粒径が０．０１～５０μm、就中０．１～２０μm、特に０．２～１０μmのシリカ、アルミナ、チタニア、ジルコニア、酸化錫、酸化インジウム、酸化カドミウム、酸化アンチモン等の導電性のこともある無機系微粒子や、架橋又は未架橋ポリマー等の有機系微粒子などの適宜なものを用いうる。

【００４９】液晶表示装置は、各構成部品を所定の配置状態で組立てることにより形成しうるが、その組立て順序等については特に限定はなく、例えば構成部品単位で

の組立て方式や、複数の構成部品を予め積層したものを単位とした組立て方式などの適宜な方式で形成することができる。

【００５０】また液晶表示装置を形成する各構成部品は、単に重ね置いて分離容易な状態にあってもよいし、接着層を介して接着一体化されていてもよい。偏光制御層としての位相差板や旋光子と導光板側の偏光板の如く光学軸の配置角度が問題となる場合などには、ズレ等を防止するために接着一体化することが好ましい。

【００５１】また位相差板や導光板等の構成部品が複数の分離素材で形成される場合にも、予め接着一体物として形成することもできる。なお接着層を介した接着一体化は、各界面での反射ロスの防止、界面への異物侵入の防止等による表示品位の低下予防などの点でも有効である。

【００５２】前記の接着層としては、適宜なものを用いうる。接着処理の簡便性などの点よりは、粘着層が好ましい。粘着層の形成には、例えばアクリル系重合体やシリコーン系ポリマー、ポリエステルやポリウレタン、ポリエーテルや合成ゴムなどの適宜なポリマーを用いてなる粘着剤を用いうる。反射ロスの防止の点よりは、屈折率が接着対象の中間値であるものが好ましい。

【００５３】本発明の透過型液晶表示装置における液晶セルは、例えばツイストネマチック液晶やスーパーツイストネマチック液晶、非ツイスト系の液晶や二色性物質を液晶中に分散させたゲストホスト系の液晶、あるいは強誘電性液晶などの適宜な液晶を用いた透過型のものであってよく、液晶の駆動方式も適宜なものであってよい。

【００５４】液晶表示装置の形成に際しては、上記した如く例えばプリズムシート等からなるプリズムアレイ層、視認側の偏光板の上に設ける拡散板やアンチグレア層、反射防止膜や保護層や保護板、あるいは液晶セルと視認側又は／及びバックライト側の偏光板の間に設ける補償位相差板などの適宜な光学素子の１層又は２層以上を適宜な位置に配置することができる。

【００５５】前記したプリズムアレイ層は、光の出射方向の制御を目的とするものであるから、視認側の偏光板の上面などの適宜な位置にも配置しうる。なお２層以上のプリズムアレイ層を配置する場合には、アレイの配列が上下の層で直交等の交差状態となるようにすることが出射方向の平準化などの点より好ましい。

【００５６】また拡散板は、光を拡散して輝度の均質化や光放射方向の拡大等を目的とするものであるから上記した導光板の上面や、視認側偏光板の上面などの適宜な位置に１層又は２層以上を配置しうる。拡散板としては、偏光板の透明保護層で例示した微細凹凸構造等の適宜な方式による拡散構造を有する透明フィルムなどの適宜なものを用いることができ、公知の拡散板のいずれも用いうる。また補償用位相差板は、液晶セル等による複

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屈折性を補償して表示の着色化防止などを目的とし、上記の位相差板に準じて延伸フィルムなどとして得ることができる。

【００５７】なお本発明においては、液晶表示装置等の表示装置を形成する位相差板や旋光子、偏光板や導光板やプリズムフレイ層、あるいはその他の拡散板や粘着層等の形成部品を、例えばサリチル酸エステル系化合物、ベンゾフェノール系化合物、ベンゾトリアゾール系化合物、シアノアクリレート系化合物、ニッケル錯塩系化合物等の紫外線吸収剤で処理する方式などにより紫外線吸収能をもたせることもできる。

【００５８】

【実施例】

実施例１

裏面にＡｌ蒸着層からなる反射層を設けたポリメチルメタクリレートからなる厚さ５mmの導光板の側面に直径４mmの冷陰極管を配置し、アルミニウム蒸着フィルムにてその導光板の側面と冷陰極管を包囲した後、導光板の上面に厚さ２０μmのアクリル系粘着層を介してポリカーボネートからなる位相差２６５nm、N_z約１．０の位相差板を接着し、その上に厚さ２０μmのアクリル系粘着層を介して両面に偏光板が接着したＴＮ型液晶セルを接着して液晶表示装置を得た。

【００５９】なお前記の位相差板は、導光板側の偏光板の透過軸が導光板の入射側面の面内法線に対し４５度で配置されているため、その進相軸が当該面内法線に対し２２．５度の角度となるように配置した。またＴＮ型液晶セルは、両面の偏光板の透過軸が直交したノーマリーホワイトタイプのものである。

【００６０】実施例２

位相差が２１０nmで、N_zが約１．０の位相差板を用いたほかは、実施例１に準じて液晶表示装置を得た。

【００６１】実施例３

位相差板を遅相軸（延伸軸）に基づいて配置したほかは、実施例１に準じて液晶表示装置を得た。

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＊【００６２】実施例４

導光板と位相差板の間にプリズムシートをプリズム頂点の稜線が導光板の入射側面方向と平行となるように配置し、かつ位相差板を遅相軸に基づいて配置したほかは、実施例１に準じて液晶表示装置を得た。

【００６３】実施例５

位相差が２６５nmで、N_zが約２．５の位相差板を用いたほかは、実施例４に準じて液晶表示装置を得た。

【００６４】実施例６

位相差板に代えて、ＴＮ（ツイストネマチック）構造の液晶ポリマーフィルムからなる旋光角が２２．５度の旋光子を用いたほかは、実施例１に準じて液晶表示装置を得た。

【００６５】実施例７

位相差板に代えて、ＴＮ（ツイストネマチック）構造の液晶ポリマーフィルムからなる旋光角が２２．５度の旋光子を用いたほかは、実施例４に準じて液晶表示装置を得た。

【００６６】比較例１

位相差板を配置しないほかは実施例１に準じて液晶表示装置を得た。

【００６７】比較例２

位相差板を配置しないほかは実施例４に準じて液晶表示装置を得た。

【００６８】参考試験

実施例に準じた導光板からなる光源の上に偏光板を、その透過軸が導光板の入射側面の面内法線方向（主導光方向）、プリズムシートを有する場合にはプリズム頂点の稜線方向（プリズム方向）又はそれらに直交する方向となるように配置して導光板中央部でのバックライト点灯時における正面（画面垂直方向）輝度を調べた。測定は、色差計（ミノルタ社製、ＣＳ－１００）にて暗室中で行った。

【００６９】前記の結果を表１に示した。

【表１】

	プリズムシート無し		プリズムシート有り	
	主導光方向	同左直交方向	プリズム方向	同左直交方向
輝度(cd／㎡)	２４１	２０１	３６９	４４６

【００７０】表１より、偏光板の透過軸の配置角度で正面輝度が相違し、プリズムシートが無い場合には主導光方向（入射側面の面内法線方向）が、有る場合にはプリズム方向（プリズム頂点の稜線方向）に直交する方向がそれらの垂直方向よりも輝度が高く、その方向に偏光板透過率に基づく光の偏りの有ることがわかる。かかる偏りは、導光板の出射面の全面で確認された。

【００７１】評価試験

実施例、比較例で得た液晶表示装置の視認側におけるバックライト点灯時の非選択状態における正面と上斜め４５度方向の輝度を調べた。その結果を表２に示した。

【００７２】

【表２】

	輝　度(cd／㎡)	
	正　面	４５度方向
実施例１	７３	５１
実施例２	７１	５１
実施例３	７３	４３
実施例４	１２７	８８
実施例５	１２４	８０
実施例６	７３	５１
実施例７	１２７	８８
比較例１	６５	４５
比較例２	１０８	７４

【００７３】表２より、プリズムシートが無い場合には比較例１に対して実施例１，３，６では約１２％、実施例２では約９％、正面輝度が向上していることがわかり、プリズムシートが有る場合には比較例２に対して実施例４，７では約１８％、実施例５では約１５％、正面輝度が向上していることがわかる。また実施例１と３、及び４と５の対比より、斜め透過光に対しては、位相差板を進相軸に基づいて配置することが輝度向上の点より有利であることがわかる。

【図面の簡単な説明】

【図１】液晶表示装置例の断面図

【図２】他の液晶表示装置例の断面図

【図３】さらに他の液晶表示装置例の断面図

【図４】さらに他の液晶表示装置例の断面図

【符号の説明】

１，６：導光板

１１：光源

１２，６１：反射層

２：位相差板

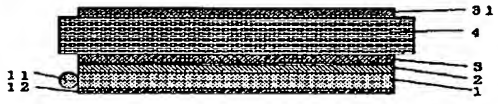
３，３１：偏光板

４：液晶セル

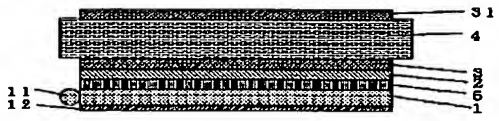
５：プリズムアレイ層

７：旋光子

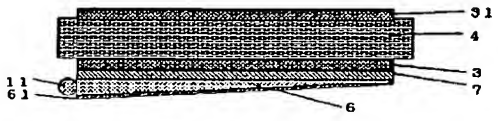
【図１】



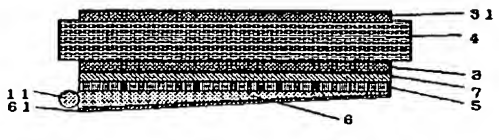
【図２】



【図３】



【図４】



フロントページの続き

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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the liquid crystal display of the transparency mold by the lighting of a display device which is excellent in the use effectiveness of light and can attain a bright display, and its approach.
[0002]
[Background of the Invention] The liquid crystal display of the transparency mold which comes to arrange the compensation phase contrast plate for coming to arrange the liquid crystal cell which has a polarizing plate at both sides on the light guide plate mold light source which consists of a light guide plate which was made to carry out outgoing radiation of the incident light from a side face from one side of a vertical side, and compensating the optical property by the birefringence of a liquid crystal cell between a polarizing plate and a liquid crystal cell conventionally if needed was known. The arrangement include angle based on the transparency shaft of the polarizing plate by the side of a light guide plate etc. is determined based on the direction of orientation of liquid crystal, for example, is 45 degrees or -45 degrees usually in a TN liquid crystal.
[0003] However, 50% or more was absorbed by the polarizing plate usually [of the light which carried out incidence to the polarizing plate by the side of a light guide plate from the light guide plate mold light source], the absorption loss was large, it was inferior to the use effectiveness of light, and there was a trouble which obstructs that the brightness of a display of a liquid crystal display improves. Although it is possible to raise the brightness of the light source and to aim at improvement in brightness, light source temperature also rises with ****, an optical strain becomes easy to generate being accompanied by improvement in power consumption in that case in a polarizing plate etc., and it becomes easy for display grace to fall.
[0004]
[The technical technical problem of invention] This invention makes a technical problem development of the transparency mold liquid crystal display which is excellent in the lighting of a display device which can attain the unnecessary and bright display of improvement-izing of the light source brightness accompanied by improvement in power consumption, and the brightness of a display by aiming at improvement in efficiency for light utilization.
[0005]
[Means for Solving the Problem] This invention the incident light from a side face to the optical outgoing radiation side of the light guide plate which carries out outgoing radiation from one side of a vertical side Prepare the polarization control layer to which the plane of vibration of the linearly polarized light is changed, and the polarization control layer is minded. The liquid crystal display using the lighting of the display device characterized by raising the parallelism of the plane of vibration of the linearly polarized light over the transparency shaft of the polarizing plate by the side of the light guide plate prepared in the transparency mold display device which carried out outgoing radiation from the light guide plate, and

carrying out incidence of the linearly polarized light to said polarizing plate, and its approach is offered.
[0006]
[Effect of the Invention] According to this invention, incidence of the linearly polarized light with high parallelism with the transparency shaft can be carried out to a polarizing plate, the absorption loss by the polarizing plate can be controlled, and even if it uses the same light source as the former by increase of polarizing plate permeability, the brightness of the display in display devices, such as a liquid crystal display, can be raised. Moreover, when considering as the same brightness as the former, the brightness of the light source can be fallen, power consumption can be reduced, and the battery life in the display device of cell power-source types, such as a portable PASONARU computer, can be raised.
[0007] The aforementioned effectiveness includes many P polarization in the linearly polarized light rather than S polarization from the relation between whenever [incident angle /, such as a Brewster's angle of the light which carried out oblique incidence to the interface of the medium by which refractive indexes differ,], and reflective conditions, when outgoing radiation light from a light guide plate is made into the partially polarized light. Therefore, so that the plane of vibration of the P polarization is controlled, and the use effectiveness of light may be raised by making a polarizing plate easy to penetrate and it may get It is thought that it is because polarization properties containing the elliptically polarized light which carried out outgoing radiation, such as a plane of vibration of polarization and an ovality, are changed through a polarization control layer from a light guide plate, it becomes easy to penetrate the polarizing plate by the side of a light guide plate, an absorption loss is controlled and permeability improves.
[0008]
[Embodiment of the Invention] The lighting of this invention raises the parallelism of the plane of vibration of the linearly polarized light over the transparency shaft of the polarizing plate by the side of the light guide plate which prepared the polarization control layer to which the plane of vibration of the linearly polarized light is changed, and was prepared in the transparency mold display device through the polarization control layer which carried out outgoing radiation from the light guide plate, and makes said polarizing plate carry out incidence of the linearly polarized light to the optical outgoing radiation side of the light guide plate which carries out outgoing radiation of the incident light from a side face from one side of a vertical side.
[0009] While operation of the lighting of the above mentioned display device arranges a phase contrast plate to the optical outgoing radiation side of the light guide plate which carries out outgoing radiation of the incident light from a side face from one side of a vertical side and arranging a transparency mold display device through a polarizing plate to the phase contrast plate up side It can carry out by making it located in the middle of an angle when the field inside distance line to the incidence side face of a light guide plate and the transparency shaft of the polarizing plate by the side of a light guide plate form the optical axis on the occasion of arrangement of said phase contrast plate.
[0010] The liquid crystal display which enforced said lighting to drawing 1 was illustrated. For a light guide plate and 2, a phase contrast plate and 3 are [the polarizing plate by the side of a light guide plate and 4] the liquid crystal cells of a transparency mold, and 1 is arranged so that the phase contrast plate 2 may be located in the middle of the angle which a field inside distance line [as opposed to the incidence side face of a light guide plate 1 in the optical axis] and the transparency shaft of the polarizing plate 3 by the side of a light guide plate make. In addition, as for the light source and 12, 11 in drawing is [a reflecting layer and 31] the polarizing plates by the side of a check by looking.
[0011] Moreover, other liquid crystal displays which enforced the aforementioned lighting to drawing 2 were illustrated. This uses for an optical outgoing radiation side the light guide plate 1 which has the prism array layer 5. In this case, the phase contrast plate 2 is arranged at the condition of being located in the prism array layer 5 bottom in the middle of the angle which the vertical line [as opposed to the ridgeline of the prism top-most vertices of the prism array layer 5 in that optical axis] of the direction of a flat surface and the transparency shaft of the polarizing plate 3 by the side of a light guide plate make.
[0012] In the liquid crystal display of the instantiation to the above, when the prism array layer 5 has the

outgoing radiation light, after carrying out outgoing radiation of the incident light from the light source 11 which the light guide plate 1 has arranged on the side face from a top face through a base etc., penetrating it and carrying out incidence to the phase contrast plate 2, incidence is carried out to a polarizing plate 3, a liquid crystal cell 4, and the check-by-looking side polarizing plate 31 one by one, and outgoing radiation of the display light is carried out from the polarizing plate 31.

[0013] Therefore, the phase contrast plate 2 is used for the example of above-mentioned drawing 1 and drawing 2 as a polarization control layer to which the plane of vibration of the linearly polarized light is changed. According to this, the plane of vibration of the linearly polarized light of the light which carried out outgoing radiation from the light guide plate 1 or the prism array layer 5 Since it was changed when penetrating the phase contrast plate 2 as a polarization control layer, and the arrangement include angle of the optical axis of the phase contrast plate was made into said middle, in case outgoing radiation is carried out from a phase contrast plate It becomes the transparency shaft of the polarizing plate 3 by the side of a light guide plate, and the linearly polarized light which has a plane of vibration with high parallelism, and the absorption loss by the polarizing plate 3 by the side of a light guide plate is controlled by that cause, permeability increases, and the brightness of a transparency mold liquid crystal display improves.

[0014] Like the above, the polarization control layer to which the plane of vibration of the linearly polarized light in this invention is changed controls the polarization condition of the light which carried out outgoing radiation from the light guide plate or the prism array layer, and aims at changing into the light which is easy to penetrate the polarizing plate by the side of a light guide plate without an absorption loss. Therefore, as a polarization control layer, the proper optical element in which the plane of vibration of the linearly polarized light is changed, and it deals can be used, for example like a phase contrast plate or a rotatory-polarization child.

[0015] The liquid crystal display which used the rotatory-polarization child 7 for drawing 3 and drawing 4 , and incidentally enforced lighting of this invention was illustrated. In the liquid crystal display of the instantiation to drawing 3 , the rotatory-polarization child 7 who replaces the above-mentioned phase contrast plate 2 is stationed on the light guide plate 6, and what indicates the angle of rotation of the range of **10 degrees to be a field inside distance line to the incidence side face of a light guide plate 6 as the rotatory-polarization child based on light with a wavelength of 550nm to the include angle which the transparency shaft of the polarizing plate 3 by the side of a light guide plate makes is used.

[0016] On the other hand with the liquid crystal display of instantiation, the light guide plate 6 which has the prism array layer 5 is used for drawing 4 at the optical outgoing radiation side, and what shows the angle of rotation of the range of **10 degrees based on light with a wavelength of 550nm is used to the include angle which the transparency shaft of the vertical line of the direction of a flat surface to the ridgeline of the prism top-most vertices in a prism array layer and the polarizing plate by the side of a light guide plate makes as that rotatory-polarization child 7 in this case.

[0017] In the liquid crystal display of the instantiation to said drawing 3 and drawing 4 , when the prism array layer 5 has the outgoing radiation light, after carrying out outgoing radiation of the incident light from the light source 11 which the light guide plate 6 has arranged on the side face from a top face through a base etc., penetrating it and carrying out incidence to the rotatory-polarization child 7, incidence is carried out to a polarizing plate 3, a liquid crystal cell 4, and the check-by-looking side polarizing plate 31 one by one, and outgoing radiation of the display light is carried out from the polarizing plate 31.

[0018] In the above, the plane of vibration of the linearly polarized light of the light which carried out outgoing radiation from the light guide plate 6 or the prism array layer 5 From having used what is changed in case the rotatory-polarization child 7 as a polarization control layer is penetrated, and shows a predetermined angle of rotation as the rotatory-polarization child, in case outgoing radiation is carried out from a rotatory-polarization child It becomes the transparency shaft of the polarizing plate 3 by the side of a light guide plate, and the linearly polarized light which has a plane of vibration with high parallelism, and the absorption loss by the polarizing plate 3 by the side of a light guide plate is controlled

by that cause, permeability increases, and the brightness of a transparency mold liquid crystal display improves.

[0019] In addition, by the above, although the improvement operation of brightness based on the linearly polarized light was explained, it is thought that change of optical properties, such as phase contrast by the polarization control layer, was changed into the light to which light other than the linearly polarized light also tends to penetrate a polarizing plate through a polarization control layer to the improvement operation in brightness of the liquid crystal display by this invention, and has contributed to the improvement in brightness from attaining to light other than the linearly polarized light.

[0020] Like a transparency mold liquid crystal cell, the lighting of this invention can be applied to the proper display device which is made to carry out incidence of the linearly polarized light through a polarizing plate, and attains the display purpose, and can be preferably applied to a transparency mold liquid crystal display above all. The liquid crystal display of a transparency mold is formed by assembling suitably component parts, such as a prism array layer which consists of a polarizing plate, a transparency mold liquid crystal cell, a back light, a prism sheet as occasion demands, etc., and a diffusion plate, a phase contrast plate for compensation, generally, and incorporating a drive circuit etc. Using the light guide plate which carries out outgoing radiation of the incident light from a side face from one side of a vertical side as a back light, except for the point of preparing a predetermined polarization control layer between the prism array layer on the light guide plate or a light guide plate, and the polarizing plate by the side of a light guide plate, there is especially no limitation and it can form a liquid crystal display in this invention according to the former.

[0021] As a light guide plate, like the example of drawing, it has reflecting layers 12 and 61 if needed on a base, the proper thing which was made to carry out outgoing radiation of the incident light from a side face from one side of a vertical side can be used, and what carries out outgoing radiation of the light efficiently without absorption is used preferably. (The cold, heat) A well-known light guide plate etc. is the example in the conventional transparency mold liquid crystal display which arranges the light source of the linear light source of a cathode-ray tube etc., light emitting diode, etc. on the side face of a light guide plate, and was made to carry out outgoing radiation of the light transmitted to the light guide plate in the inside of a light guide plate to the one side side of a plate by diffusion, reflection, diffraction, interference, etc.

[0022] As a common light guide plate which was incidentally made to carry out outgoing radiation of the internal transmission light to an one side side, concavo-convex structure, the thing which established the array structure of detailed prism especially are raised to what prepared diffusers, such as the shape of the shape of a dot, or a stripe, in transparence, the optical outgoing radiation side of a translucent resin plate, or its base, and the base of a resin plate. The light guide plate which carries out outgoing radiation of the large light of a bias in this invention can use advantageously.

[0023] In addition, the reflecting layer prepared in the base of a light guide plate if needed may be formed as a reflecting layer with the proper specular reflection layer represented with the metal side which consists of vacuum evaporationo layers, such as the diffuse reflection layer and aluminum which are represented with a concave convex etc. for the purpose of reflection, light leak prevention, etc. of transmission light, and silver, a resin plate which prepared it, a metallic foil, etc. A reflecting layer may be prepared with proper gestalten, such as a spreading layer at the base of a light guide plate, a coating layer, or a reflecting plate.

[0024] From a light guide plate, the prism array layer arranged if needed on a light guide plate controls the direction of a course of the light which carried out outgoing radiation, and aims at the increase in quantity of light perpendicular to a light guide plate advantageous to a check by looking of a liquid crystal display which it is, and is carried out and carries out outgoing radiation in the perpendicularly near condition. The method which fabricates the optical outgoing radiation side of a light guide plate in the array structure of detailed prism can also give a prism array layer as a gestalt of a light guide plate, and attachment methods, such as a prism sheet, can also give it as a thing of another object with a light guide plate.

[0025] The array array direction of the prism array layer arranged on a light guide plate is arbitrary, and is usually made into parallel or a perpendicular direction on the incidence side face of a light guide plate. When a prism array layer is on a light guide plate in this invention, the arrangement include angle and angle of rotation of a polarization control layer are determined based on the direction of a ridgeline of the prism top-most vertices in a prism array layer instead of a light guide plate, as described above.
[0026] Proper auxiliary means, such as a light source holder for leading the outgoing radiation light from the diffusion plate and the light source for equalizing luminescence to the side face of a light guide plate on the occasion of formation of a light guide plate, can be arranged one layer or more than two-layer in a predetermined location if needed, and it can consider as a proper combination object. In addition, although between a light guide plate and prism array layers is common between a light guide plate and a polarization control layer as for the arrangement location of a diffusion plate when a prism array layer is on a light guide plate, it is not limited to this.
[0027] The phase contrast plate as a polarization control layer is for changing polarization properties, such as an ovality of the polarization which carried out incidence, and an azimuth. Conversion of an azimuth can be performed in the range of 2xi according to phase contrast with a phase contrast plate, when the angle which the polarization shaft of incidence polarization and the optical axis of a phase contrast plate make is set to xi. Incidentally, by the linearly polarized light, when 1/2 wave of phase contrast is given, include-angle change of a polarization shaft can serve as max, and change of polarization conditions, such as an ovality of outgoing radiation light, can also change only the azimuth of a plane of vibration nothing.
[0028] Therefore, the mainstream direction of a field inside distance line of optical transmission, i.e., the direction [as opposed to an incidence side face with a light guide plate], and a perpendicular direction parallel to a prism array layer flat surface [as opposed to the ridgeline of prism top-most vertices in a prism array layer], The middle of the angle which the transparency shaft of the polarizing plate by the side of a light guide plate makes, and by arranging a phase contrast plate above all, so that an optical axis may be located in a center section, and changing the azimuth of polarization through the phase contrast plate, so that it may become parallel as much as possible with the transparency shaft of the polarizing plate by the side of a light guide plate The absorption loss by the polarizing plate can be reduced and permeability can be raised. As for outgoing radiation luminous intensity (I), the angle which the transparency shaft of the plane of vibration of the linearly polarized light and a polarizing plate incidentally makes can be searched for for the reinforcement of phi and incident light by I=I0H0cos2phi with the principle of Malus, when that it is only parallel sets permeability to H0, I0 and.
[0029] What gives proper phase contrast can be used for the phase contrast plate which forms a polarization control layer, and there is especially no limitation in it. The light which carried out outgoing radiation from the light guide plate or the prism array layer has the phase contrast plate more desirable than the point, i.e., the point of using this polarization property effectively, of preventing the dissolution of the polarization property since the property as the partially polarized light which the linearly polarized light mixed to the natural light is shown which gives the phase contrast of m lambda+lambda / 2 (however, m arbitrary integers and lambda wavelength).
[0030] Moreover, as for m, it is more desirable than the wavelength light which the wavelength range which does not suit the aforementioned formula by wavelength dispersion increases, and cancels the aforementioned polarization property will increase if the aforementioned m increases that it is 0. Therefore, the phase contrast plate in which the phase contrast of lambda/2 thru/or its near is shown in a large wavelength region is desirable, and the phase contrast plate in which the phase contrast of lambda/2 thru/or its near is shown in a 500-580mm wavelength region, especially the phase contrast plate in which 200-300nm phase contrast is shown based on light with a wavelength of 550nm are more desirable than the point that the check-by-looking light of a liquid crystal display is the light, above all 400-700nm.
[0031] The arrangement include angle based on the optical axis of a phase contrast plate can be suitably determined according to the phase contrast etc. When the include angle of the transparency shaft of the

polarizing plate by the side of thetaT and a light guide plate is set [the include angle of a field inside distance line / as opposed to thetaR and the incidence side face of a light guide plate for the include angle of the optical axis of a phase contrast plate] to thetaP for the include angle of the direction of a ridgeline of the prism top-most vertices of thetaL and a prism array layer rather than points, such as improvement in brightness, Formula: It is desirable that it is in the range whose thetaR is **5 degree to theta defined by theta= (thetaL+thetaP)/2 or (thetaT+thetaP) /2.

[0032] When especially a phase contrast plate give lambda/2 of phase contrast , the arrangement which located the optical axis in the center section (middle) of the angle which the perpendicular direction of the direction of a flat surface over the ridgeline of the prism top-most vertices and the transparency shaft of the polarizing plate by the side of a light guide plate make with the light guide plate which prepared the direction of a field inside distance line over the incidence side face of a light guide plate and the prism array layer as describe above be more desirable than points , such as improvement in brightness .

[0033] Moreover, as for the optical axis which determines the arrangement include angle of a phase contrast plate, in the above, considering as a phase leading shaft is more desirable than points, such as a deployment of the slanting transmitted light. In a lagging axis, the polarizing plate permeability of the check-by-looking light in the case of the direction of optical-axis change of a phase contrast plate and polarization shaft change of a polarizing plate over the slanting transmitted light being reversed, and checking the slanting transmitted light, therefore a liquid crystal display by looking from across may fall.

[0034] The phase contrast plate with which it is satisfied of 0 <=Nz<=3 based on Nz defined by formula:Nz=(nx-nz)/(nx-ny) is more desirable than the point of achieving equalization of the optical-axis variation of a phase contrast plate, and the polarization shaft variation of a polarizing plate, and increasing permeability, especially the point of also increasing the above mentioned permeability of the slanting transmitted light. In addition, the refractive index within a field of a phase contrast plate (however, nx>=ny) and nz of nx and ny are the refractive indexes of the thickness direction. Nz -- said -- if out of range, it is deficient in the permeability enhancement effect of the slanting transmitted light.

[0035] The phase contrast plate which forms a polarization control layer may consist of a phase contrast layer more than one layer or two-layer for the purpose of control of phase contrast etc. Superposition of the phase contrast layer more than two-layer [phase contrast is different from], or the superposition which made the optical axis of the phase contrast layer with the same phase contrast which carries out a **** difference cross is effective in expansion of the wavelength region changed into the target polarization property.

[0036] The proper thing which shows form birefringence can be used for a phase contrast plate thru/or the phase contrast layer which forms it. Incidentally as the example, the film which comes to carry out extension processing of the high polymer film with one shaft, two shafts, etc. suitably, the phase contrast film which consists of a liquid crystal polymer film etc. are raised. As an example of said high polymer film, the film which consists of a polycarbonate, polyester, polysulfone, polyether sulphone, polyvinyl alcohol, polystyrene, polymethylmethacrylate, polypropylene, other polyolefines, a cellulose acetate system polymer, a polyvinyl chloride, polyarylate, and proper transparence plastics like a polyamide is raised.

[0037] A phase contrast plate has the low phase contrast plate of wavelength dispersion, and the desirable phase contrast plate in which anomalous dispersion is shown above all in this invention, although wavelength dispersion peculiar to the quality of the material is generally shown and the light by the side of short wavelength serves as large phase contrast more nearly usually.

[0038] The rotatory-polarization child as a polarization control layer is for changing polarization properties, such as an azimuth of the polarization which carried out incidence using the optical activity, when it considers as the pitch which the effect of phase contrast does not generate, can rotate a bearing corner chisel without the change of state of polarization, and can change. Conversion of the azimuth by the rotatory-polarization child can be expressed as an angle of rotation theta, and when the angle which the polarization shaft of incidence polarization and the transparency shaft of a light guide plate side

polarizing plate make by making the polarization direction of shaft rotation into the forward direction is set to eta, the rotatory-polarization child who shows the angle of rotation which satisfies n.180 degree < theta<n and 180 degree +2eta (however, n arbitrary integers) can use it. The rotatory-polarization child who shows the angle of rotation of theta=n and 180 degree +eta is more desirable than points, such as improvement in brightness. moreover, the thing which has n smaller than the point of control of wavelength dispersion -- the thing of 0 is desirable above all.

[0039] with the light guide plate a light guide plate have arrange the field inside distance line to an incidence side face or prism array layer of a light guide plate , the rotatory polarization child who show the angle of rotation of the range of ** 10 degrees based on light with a wavelength of 550 nm be preferably use for formation of a liquid crystal display from the point of the improvement in a brightness etc. to the include angle which the transparency shaft of the vertical line of the direction of a flat surface to the ridgeline of the prism top-most vertices in the prism array layer and the polarizing plate by the side of a light guide plate make .

[0040] A rotatory-polarization child may consist of the proper quality of the material which shows optical activity. As the example, low-molecular-weight liquid crystal, the amount liquid crystal of macromolecules, or the thing that combined them is raised. Liquid crystal more desirable than points, such as optical activity, shows twist NEMAKKU structure.

[0041] The rotatory-polarization child who consists of liquid crystal can get with a gestalt with proper gestalt which supported the layer which consists of the cel gestalt, the amount liquid crystal of macromolecules, or the liquid crystal polymer which pinched for example, the low-molecular-liquid-crystal layer with transparence base materials, such as a film, with the transparence base material, gestalt which consists of a film of a liquid crystal polymer, gestalt which superimposed those gestalt objects in proper combination. A liquid crystal polymer film can form a liquid crystal polymer layer on the base material which prepared for example, the exfoliation coat, and can obtain it with the method which exfoliates from a base material.

[0042] As the aforementioned transparence base material, proper things, such as a film which consists of plastics like triacetyl cellulose, polyvinyl alcohol and polyimide, polyarylate and polyester, a polycarbonate, polysulfone and polyether sulphone, and epoxy system resin, for example, or a glass plate, can be used.

[0043] Formation of a liquid crystal layer can be performed by the approach according to the conventional orientation processing. Incidentally as the example, what formed film, such as polyimide and polyvinyl alcohol, on the base material, and carried out rubbing processing with the rayon cloth etc., the method which develops liquid crystal on the proper orientation film which consists of a method vacuum evaporationo layer of slanting of SiO2 etc. are held. Proper coaters, such as a bar coating machine, a spinner and a roll coater, and a gravure method, can perform expansion.

[0044] In addition, in the case of a polymer liquid crystal thru/or a liquid crystal polymer, after developing liquid crystal on the orientation film, more than glass transition temperature, it heats under to isotropic phase transition temperature, and orientation of the liquid crystal is carried out, and it is cooled under to glass transition temperature, it considers as a vitreous state, and the method which forms the flozen layer by which the orientation concerned was fixed is held.

[0045] Expansion of a polymer liquid crystal thru/or a liquid crystal polymer can be performed as a solution by the heating melting method or the solvent. As the solvent, proper things, such as a methylene chloride, a cyclohexanone and a trichloroethylene, tetrachloroethane and N-methyl pyrrolidone, and a tetrahydrofuran, can be used, for example. On the occasion of expansion, the superposition method of the liquid crystal layer which minded the orientation film if needed etc. can be taken.

[0046] A proper thing may be used as the light guide plate side of display devices, such as a transparency mold liquid crystal cell, and a polarizing plate arranged at a check-by-looking side if needed, and there is especially no limitation. Generally, what consists of a polarization film is used. As the example, the polyene oriented film like a thing, the dehydration processing object of polyvinyl alcohol, or the demineralization acid-treatment object of a polyvinyl chloride which iodine and/or dichromatic dye were made to stick to the film of the hydrophilic giant molecule like a polyvinyl alcohol system, a partial

formal-ized polyvinyl alcohol system, and an ethylene-vinylacetate copolymer system partial saponification object, and was extended is raised.
[0047] Above all, the thing which made iodine and/or dichromatic dye stick to a hydrophilic high polymer film from points, such as degree of polarization, can use preferably. Although the thickness of a polarization film is 5-80 micrometers usually, it is not limited to this. The polarizing plate to be used may be what covered one side or both sides of a polarization film with transparent protection layer etc. Moreover, the transparent protection layer may have detailed irregularity structure on a front face by adhesion and content of a particle.
[0048] Mean particle diameter can use especially for the aforementioned particle above all 0.01-50 micrometers of what [, such as organic system particles, such as a certain inorganic system particle, and bridge formation or non-crosslinked polymer,] are [conductive things, such as the silica which is 0.2-10 micrometers, an alumina, a titania, a zirconia, tin oxide, indium oxide, cadmium oxide, and antimony oxide,] proper 0.1-20 micrometers.
[0049] Although a liquid crystal display can be formed by assembling each component part in the state of predetermined arrangement, there is especially no limitation about the compose sequence, for example, it can form by the method with proper assembly method in a component part unit, assembly method which made unit what carried out the laminating of two or more component parts beforehand.
[0050] moreover, each component part which forms a liquid crystal display -- only -- piling up -- placing -- separation -- you may be in an easy condition and adhesion unification may be carried out through the glue line. When the arrangement include angle of an optical axis poses a problem like the polarizing plate by the side of the phase contrast plate as a polarization control layer, or a rotatory-polarization child and a light guide plate, in order to prevent gap etc., it is desirable to carry out adhesion unification.
[0051] Moreover, also when component parts, such as a phase contrast plate and a light guide plate, are formed for two or more separation materials, it can also really [adhesion] form as an object beforehand. In addition, the adhesion unification through a glue line is effective also in respect of fall prevention of the display grace by prevention of the reflective loss in respect of each field, prevention of the foreign matter invasion to an interface, etc.
[0052] A proper thing can be used as the aforementioned glue line. An adhesive layer is more desirable than points, such as the simple nature of adhesion processing. The binder which comes to use proper polymers, such as for example, an acrylic polymer, a silicone system polymer and polyester, polyurethane and a polyether, and synthetic rubber, can be used for formation of an adhesive layer. That whose refractive index is a mean value for adhesion is more desirable than the point of prevention of a reflective loss.
[0053] The liquid crystal cell in the transparency mold liquid crystal display of this invention may be the thing of the transparency mold using proper liquid crystal, such as for example, a twist nematic liquid crystal, a super twist nematic liquid crystal, liquid crystal of the guest host system which distributed the liquid crystal and the dichroism matter of a non-twisting system in liquid crystal, or a ferroelectric liquid crystal, and its drive method of liquid crystal may also be proper.
[0054] On the occasion of formation of a liquid crystal display, it can arrange more than two-layer [of proper optical elements, such as a compensation phase contrast plate formed between the polarizing plates by the side of the prism array layer which consists of a prism sheet etc. as described above, the diffusion plate formed on the polarizing plate by the side of a check by looking and an anti glare layer, the antireflection film and a protective layer, a guard plate or a liquid crystal cell, a check by looking, or/and a back light, / one layer or two-layer] in a proper location.
[0055] Since the above mentioned prism array layer aims at control of the direction of outgoing radiation of light, it can be arranged also in the location where the top face of the polarizing plate by the side of a check by looking etc. is proper. In addition, when arranging the prism array layer more than two-layer, it is more desirable than points, such as equalization of the direction of outgoing radiation, to make it the array of an array be in crossover conditions, such as a rectangular cross, in an up-and-down layer.
[0056] Moreover, a diffusion plate can arrange one layer or more than two-layer in the location where the

top face of the light guide plate described above since light is diffused and it aims at homogenization of brightness, expansion of the direction of luminous radiation, etc., the top face of a check-by-looking side polarizing plate, etc. are proper. Proper things, such as a bright film which has the diffusion structure by proper methods, such as detailed irregularity structure illustrated by the transparent protection layer of a polarizing plate, as a diffusion plate, can be used, and all of a well-known diffusion plate can be used. Moreover, the phase contrast plate for compensation can compensate the form birefringence by a liquid crystal cell etc., and can acquire it as an oriented film etc. according to the above-mentioned phase contrast plate for the purpose of coloring-ized prevention of a display etc.

[0057] In addition, in this invention, ultraviolet absorption ability can also be given with the method which processes formation components, such as a phase contrast plate which forms displays, such as a liquid crystal display, a rotatory-polarization child and a polarizing plate, a light guide plate, a prism FUREI layer, or other diffusion plates, an adhesive layer, with ultraviolet ray absorbents, such as for example, a salicylate system compound, a benzophenol system compound, a benzotriazol system compound, a cyanoacrylate system compound, and a nickel complex salt system compound.

[0058]

[Example]

A cold cathode tube with a diameter of 4mm is arranged on the side face of a light guide plate with a thickness of 5mm it is thin from the polymethylmethacrylate which prepared the reflecting layer which consists of an aluminum vacuum evaporationo layer in example 1 rear face. After surrounding the side face and cold cathode tube of the light guide plate with a vacuum-plating-of-aluminium film, The TN liquid crystal cel which pasted up 265nm of phase contrast and the phase contrast plate of Nz 1.0 [about] which consist of a polycarbonate through an acrylic adhesive layer with a thickness of 20 micrometers on the top face of a light guide plate, and the polarizing plate pasted up to both sides through the acrylic adhesive layer with a thickness of 20 micrometers on it was pasted up, and the liquid crystal display was obtained.

[0059] In addition, since the transparency shaft of the polarizing plate by the side of a light guide plate is arranged at 45 degrees to the field inside distance line of the incidence side face of a light guide plate, the aforementioned phase contrast plate has been arranged so that the phase leading shaft may serve as an include angle of 22.5 degrees to the field inside distance line concerned. Moreover, a TN liquid crystal cel is the thing of the no MARI White type with which the transparency shaft of a double-sided polarizing plate intersected perpendicularly.

[0060] By 210nm, Nz used the phase contrast plate of about 1.0, and also example 2 phase contrast obtained the liquid crystal display according to the example 1.

[0061] The example 3 phase-contrast plate has been arranged based on a lagging axis (extension shaft), and also the liquid crystal display was obtained according to the example 1.

[0062] Between example 4 light guide plate and a phase contrast plate, have arranged the prism sheet so that the ridgeline of prism top-most vertices may become parallel to the direction of an incidence side face of a light guide plate, and the phase contrast plate has been arranged based on a lagging axis, and also the liquid crystal display was obtained according to the example 1.

[0063] By 265nm, Nz used the phase contrast plate of about 2.5, and also example 5 phase contrast obtained the liquid crystal display according to the example 4.

[0064] the angle of rotation which consists of a liquid crystal polymer film of TN (the twist -- nematic) structure used the rotatory-polarization child who is 22.5 degrees, and also it replaced with the example 6 phase-contrast plate, and the liquid crystal display was obtained according to the example 1.

[0065] the angle of rotation which consists of a liquid crystal polymer film of TN (the twist -- nematic) structure used the rotatory-polarization child who is 22.5 degrees, and also it replaced with the example 7 phase-contrast plate, and the liquid crystal display was obtained according to the example 4.

[0066] An example of comparison 1 phase-contrast plate has not been arranged, and also the liquid crystal display was obtained according to the example 1.

[0067] An example of comparison 2 phase-contrast plate has not been arranged, and also the liquid

crystal display was obtained according to the example 4.

[0068] On the light source which consist of a light guide plate according to a reference test example , it have arrange so that it may become the direction which intersect perpendicularly with the direction of a ridgeline of prism top-most vertices (the direction of prism) , or they when the transparency shaft have the direction of a field inside distance line of the incidence side face of a light guide plate (the direction of initiative light) , and a prism sheet about a polarizing plate , and the transverse plane (screen perpendicular direction) brightness at the time of back light lighting in a light guide plate center section be investigated . The color difference meter (the Minolta Co., Ltd. make, CS-100) performed measurement all over the dark room.

[0069] The aforementioned result was shown in Table 1.

[Table 1]

	プリズムシート無し		プリズムシート有り	
	主導光方向	同左直交方向	プリズム方向	同左直交方向
輝度(cd/㎡)	241	201	369	446

[0070] When transverse-plane brightness is different at the transparency shaft-configuration include angle of a polarizing plate and there is no prism sheet from Table 1, the direction of brightness where it intersects perpendicularly in the direction of prism (the direction of a ridgeline of prism top-most vertices) when there is the direction of initiative light (the direction of a field inside distance line of an incidence side face) is higher than those perpendicular directions, and it turns out that there is a bias of light based on polarizing plate permeability in the direction. This bias was checked all over the outgoing radiation side of a light guide plate.

[0071] The brightness of the transverse plane in the condition at the time of back light lighting by the side of a check by looking of the liquid crystal display obtained in the evaluation trial example and the example of a comparison of not choosing, and the direction of 45 top slant was investigated. The result was shown in Table 2.

[0072]

[Table 2]

	輝 度(cd/㎡)	
	正 面	４５度方向
実施例１	７３	５１
実施例２	７１	５１
実施例３	７３	４３
実施例４	１２７	８８
実施例５	１２４	８０
実施例６	７３	５１
実施例７	１２７	８８
比較例１	６５	４５
比較例２	１０８	７４

[0073] Table 2 shows that transverse-plane brightness is improving about 15% by the example 5 about 18% in the examples 4 and 7 to the example 2 of a comparison, when it turns out that transverse-plane brightness is improving about 9% in the example 2 about 12% and there is [as opposed to / when there is no prism sheet / the example 1 of a comparison] a prism sheet in the examples 1, 3, and 6. Moreover, examples 1 and 3 and contrast of 4 and 5 show that it is more advantageous than the point of the improvement in brightness to arrange a phase contrast plate based on a phase leading shaft to the slanting transmitted light.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] Lighting of the display device characterized by raising the parallelism of the plane of vibration of the linearly polarized light over the transparency shaft of the polarizing plate by the side of the light guide plate which prepared the polarization control layer to which the plane of vibration of the linearly polarized light is changed, and was prepared in the transparency mold display device through the polarization control layer which carried out outgoing radiation from the light guide plate, and making said polarizing plate carry out incidence of the linearly polarized light to the optical outgoing radiation side of the light guide plate which carries out outgoing radiation of the incident light from a side face from one side of a vertical side.
[Claim 2] The light guide plate which carries out outgoing radiation of the incident light from a side face from one side of a vertical side, the phase contrast plate arranged at the optical outgoing radiation side, A field inside distance line [as opposed to / come at least to have the transparency mold liquid crystal cell arranged through a polarizing plate at the phase contrast plate bottom, and / the incidence side face of a light guide plate in the aforementioned phase contrast plate], The liquid crystal display characterized by being arranged so that an optical axis may be located in the middle of the angle which the transparency shaft of the polarizing plate by the side of a light guide plate makes.
[Claim 3] The light guide plate which carries out outgoing radiation of the incident light from a side face from one side of a vertical side, and has a prism array layer in the optical outgoing radiation side, It comes at least to have the phase contrast plate arranged at the prism array layer bottom, and the transparency mold liquid crystal cell arranged through a polarizing plate at the phase contrast plate bottom. The liquid crystal display characterized by being arranged so that an optical axis may be located in the middle of the angle which the vertical line of the direction of a flat surface to the ridgeline of prism top-most vertices [in / in the aforementioned phase contrast plate / a prism array layer] and the transparency shaft of the polarizing plate by the side of a light guide plate make.
[Claim 4] When the include angle of the transparency shaft of the polarizing plate by the side of thetaT and a light guide plate is set [the include angle of a field inside distance line / as opposed to thetaR and the incidence side face of a light guide plate for the include angle of the optical axis of a phase contrast plate] to thetaP for the include angle of the direction of a ridgeline of the prism top-most vertices of thetaL and a prism array layer in claim 2 or 3, Formula: The liquid crystal display which is in the range whose thetaR is **5 degree to theta defined by theta= (thetaL+thetaP)/2 or (thetaT+thetaP) /2.
[Claim 5] The liquid crystal display which is 200-300nm based on the light whose phase contrast of a phase contrast plate is the wavelength of 550nm in claims 2-4.
[Claim 6] The liquid crystal display whose optical axis which determines the arrangement include angle of a phase contrast plate in claims 2-5 is a phase leading shaft.
[Claim 7] The liquid crystal display which is what satisfies 0 <=Nz<=3 based on Nz defined by formula:Nz= (nx-nz)/(nx-ny) when a phase contrast plate sets the refractive index of nx, ny (however, nx>=ny), and the thickness direction to nz for the refractive index within the field in claims 2-6.
[Claim 8] The light guide plate which carries out outgoing radiation of the incident light from a side face

from one side of a vertical side, the rotatory-polarization child stationed at the optical outgoing radiation side, A field inside distance line [as opposed to / come at least to have the transparency mold liquid crystal cell arranged through a polarizing plate at the rotatory-polarization child bottom, and / the incidence side face of a light guide plate in the aforementioned rotatory-polarization child], The liquid crystal display characterized by being what shows the angle of rotation of the range of **10 degrees based on light with a wavelength of 550nm to the include angle which the transparency shaft of the polarizing plate by the side of a light guide plate makes.

[Claim 9] The light guide plate which carries out outgoing radiation of the incident light from a side face from one side of a vertical side, and has a prism array layer in the optical outgoing radiation side, It comes at least to have the rotatory-polarization child stationed at the prism array layer bottom, and the transparency mold liquid crystal cell arranged through a polarizing plate at the rotatory-polarization child bottom. The liquid crystal display characterized by being that the aforementioned rotatory-polarization child indicates the angle of rotation of the range of **10 degrees to be based on light with a wavelength of 550nm to the include angle which the transparency shaft of the vertical line of the direction of a flat surface to the ridgeline of the prism top-most vertices in a prism array layer and the polarizing plate by the side of a light guide plate makes.

[Claim 10] The liquid crystal display with which it comes to carry out the adhesion unification of a phase contrast plate or the rotatory-polarization child with the polarizing plate by the side of a light guide plate in claims 2-9.

[Translation done.]

* NOTICES *

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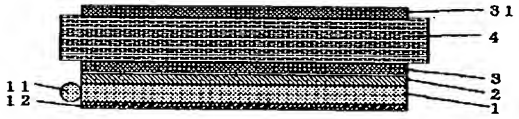
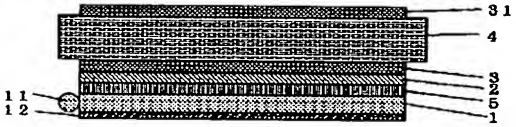
DRAWINGS

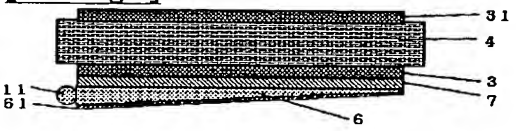
[Drawing 1]



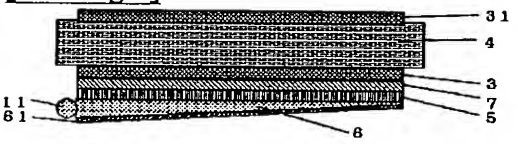
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]